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January-June 1975



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U.S. DEPARTMENT OF AGRICULTURE

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Northern Regional Research Laboratory
Agricultural Research Service
United States Department of Agriculture
1815 North University Street
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REQUEST FOR INFORMATION

Results of research investigations at the Northern Regional Research Laboratory are published regularly in the technical literature, and public-service patents are secured to cover patentable inventions and discoveries (see page 56). As a convenient guide to our publications and patents, a list with abstracts is published semiannually. These abstracts describe the current research and indicate the progress achieved. Further information on any of the developments, as well as earlier technical papers, may be obtained by writing us.

In conformance with the policy of the U.S. Department of Agriculture, Northern Laboratory publications are available to scientists and other specialists, librarians, representatives of the press, and others interested.

Reference to commercial equipment or proprietary products is made as part of the exact experimental conditions. Naming a company or product does not imply approval or

recommendation by the U.S. Department of Agriculture over others not mentioned.

Requests for specific reprints should be by number and addressed to the Northern Regional Research Laboratory. Those titles marked with an asterisk [*] are not available at the Northern Laboratory for distribution.

Most of the publications are in journals that are available in libraries. Photographic copies of most journal articles on research at this Laboratory can be purchased from the National Agricultural Library of the U.S. Department of Agriculture, Beltsville, Maryland 20705.

No publications will be sent regularly in response to foreign requests unless exchange arrangements have been made with the Director of the National Agricultural Library.

Copies of previous lists of publications and patents are available upon request.

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PUBLICATIONS

[Publications marked with an asterisk (*) are not available for distribution at the Northern Regional Research Laboratory. When requesting reprints, please order by number. Use your zip code.]

- 3627 • Mass Production of *Rhizopus oligosporus* Spores and Their Application in Tempeh Fermentation
Hwa L. Wang, E. W. Swain, and C. W. Hesseltine
J. Food Sci. 40(1): 168-170. January-February 1975

Tempeh, a popular Indonesian soybean food made with *Rhizopus oligosporus*, and tempehlike products made from other cereal grains are mild and pleasant in flavor and have a potential for use in high-protein snacks. To facilitate tempeh fermentation, attempts were made to develop a suitable inoculum. Freeze-dried *R. oligosporus* spore preparations were made by fermenting rice, rice-wheat bran, or wheat-wheat bran at a 40% moisture level for 4-5 days at 32° C. After freeze drying the spore preparations had viable spore counts of 10^7 per gram, and viability did not change significantly after 6 months of storage at 4° C. At a level of 10^6 spores per 100 grams of cooked soybeans or pearled wheat, tempeh fermentations were carried out in petri dishes, trays, and plastic bags. The inoculated beans packed in plastic bags were frozen and fermented later as needed. Either the water-insoluble fraction of soybeans or the residue from soybean milk and tofu production served as good substrates for tempeh fermentation. Tempeh made from the residue had a texture and flavor similar to french-fried potatoes. Tempeh fermentation, therefore, is an excellent way to use this residue, considered a waste.

- 3628 • Oligomeric Plasticizers from Crambe Oil-Derived Dicarboxylic Acids for Poly(vinyl chloride)
Shu-Pei Chang, Robert W. Ridgway, and George R. Riser¹
(¹Eastern Regional Research Laboratory, ARS, USDA,
Philadelphia, Pa.)
J. Am. Oil Chem. Soc. 52(1): 10-13. January 1975

A total of 17 oligomeric plasticizers were prepared by polyesterification of long-chain dicarboxylic acids, propylene glycol, and terminator acid or alcohol. All, except one terminated by dodecyl alcohol, were compatible with poly(vinyl chloride) (PVC). Films plasticized with these polyesters were similar in transparency and flexibility to films plasticized with

bis(2-ethylhexyl) phthalate (DOP). PVC sheets containing brassylic acid polyesters with M_n of 2200-2300 or a crambe mixed dicarboxylic acid polyester with M_n of 2100 exhibited superior permanence with overall performance comparable to sheets plasticized with DOP or a commercial polymeric plasticizer.

3629 • Preparation and Antitumor Activity of a Rearranged Ester of Cephalotaxine

Kenneth L. Mikolajczak, Richard G. Powell, and Cecil R. Smith, Jr.
J. Med. Chem. 18(1): 63-66. January 1975

Cephalotaxine, the major alkaloid of *Cephalotaxus harringtonia*, has been converted to a chloro compound by replacement of its hydroxyl function (accompanied predominantly by inversion) at C-3. This derivative, epi-cephalotaxyl chloride, and the chloro compound with the natural configuration retained at C-3, cephalotaxyl chloride, undergo complex rearrangements and inversions during hydrolysis with water, aqueous base, and methanolic base. Attempts to carry out a partial synthesis of one of the potential antitumor esters of cephalotaxine by treating these chloro compounds with the silver salt of the appropriate acid resulted in extensive rearrangement of the cyclopentene ring.

3630* • Collaborative Study of the Determination of Aflatoxin M₁ in Milk

I. F. H. Purchase,¹ R. D. Stubblefield, and B. A. Altenkirk¹
(¹National Research Institute for Nutritional Diseases, South African Medical Research Council, Pretoria, South Africa)
IUPAC Inf. Bull., Tech. Rep. No. 11, 21 pp. August 1974

An international collaborative study was conducted by the International Union of Pure and Applied Chemistry and the Association of Official Analytical Chemists (AOAC) to test two methods for the determination of aflatoxin M₁ in milk. Statistical analysis revealed that both methods were capable of precision comparable to other AOAC methods for agricultural commodities. These methods will be useful in monitoring samples to determine if a problem of M₁ in milk exists.

3631 • Enzyme-Converted Cationic Flours and Starches: Paper Surface Sizing and Recycling Studies

J. C. Rankin, A. J. Ernst, B. S. Phillips, B. T. Hofreiter, and W. M. Doane
Tappi 58(1): 106-108. January 1975

Surface sizes for paper were prepared by enzyme conversion of cationic aminoethyl flours and starches. Aminoethylation of corn and wheat flour and starch was accomplished with ethylenimine. In laboratory surface-sizing

studies, the sizes were comparable to commercial cationic starch sizes in improving paper strength and surface properties. All cationic products were retained well when the paper was recycled.

- 3632 • An Evaluation of Cationic Aminoethyl Cereal Flours as Wet-End Paper Additives
G. E. Hamerstrand, B. T. Hofreiter, J. C. Rankin, and
C. R. Russell
Tappi 58(1): 112-115. January 1975

Cationic aminoethyl cereal flours were evaluated as wet-end additives in five paper mills on six divergent grades of paper ranging from lightweight bag to highly filled bond paper. When the flours were compared directly with both commercial cationic and unmodified starches, they were equivalent or superior in performance and economics. Parallel evaluations were conducted on a 32-inch pilot paper machine to assess the credibility of pilot trials.

- 3633 • Lipid Metabolism During Bacterial Growth, Sporulation, and Germination: Kinetics of Fatty Acid and Macromolecular Synthesis During Spore Germination and Outgrowth of *Bacillus thuringiensis*
Kenneth W. Nickerson, John DePinto, and Lee A. Bulla, Jr.
J. Bacteriol. 121(1): 227-233. January 1975

The timing and kinetics of fatty acid synthesis are delineated for *Bacillus thuringiensis* spore germination and outgrowth by analyzing [$U-^{14}C$]acetate and [$2-^3H$]glycerol incorporation into chloroform-methanol-extractable and trichloroacetic acid-precipitable lipids. In addition to measurement of pulsed and continuous labeling of fatty acids, monitoring the incorporation of radioactive phenylalanine, thymidine, and uridine from the onset of germination through first cell division provides a profile of biochemical activities related to membrane differentiation and cellular development. Upon germination, ribonucleic acid synthesis is initiated, immediately followed by rapid and extensive fatty acid synthesis that in turn precedes protein, deoxyribonucleic acid, and triglyceride synthesis. Significantly, formation of fatty acids from acetate exhibits further developmental periodicity in which a large transient increase in fatty acid synthetic activity coincides with the approach of cell division. Radiorespirometric analyses indicate only slight oxidative decarboxylation of acetate and corroborate the extreme involvement of acetate in specific fatty acid biosynthetic reactions throughout cellular modification. These findings graphically demonstrate an intimate association of fatty acid metabolism with commitment to spore outgrowth and subsequent cell division.

- 3634 • *Scopulariopsis brevicaulis*: Effect of pH and Substrate on Growth

R. J. Bothast, E. B. Lancaster, and C. W. Hesseltine
Eur. J. Appl. Microbiol. 1(1): 55-66. 1975

Scopulariopsis brevicaulis Bainier NRRL 5867, isolated from ammonia-treated corn during preservation studies, was grown in shaken and still liquid cultures on Blakeslee's malt extract. The medium was adjusted to different pH values between 5.0 and 10.6 with sodium hydroxide and ammonium hydroxide. Maximum mycelium was produced at an initial pH of 9.0-10.0. Considerably more mycelium was produced in shaken flasks than in still cultures. When the initial pH was adjusted to 10.0 with ammonium hydroxide, 1350 mg. mycelium/200 ml. Blakeslee's malt extract was produced in contrast to 540 mg. with sodium hydroxide. Approximately 28% of the total solids and 25% of the nitrogen in an ammoniated corn infusion broth were converted to mold mycelium high in essential amino acids and protein by both NRRL 5867 and NRRL 3273, another strain of *S. brevicaulis*. When *S. brevicaulis* was grown 7 days on a solid substrate of ammoniated corn, ammonia was converted to organic material, carbohydrate was utilized, and protein of the fermented corn increased in lysine and methionine. Approximately 9% of the weight of the corn was lost during the process.

- 3635* • Physiology of Sporeforming Bacteria Associated with Insects.
 V. Tricarboxylic Acid Cycle Activity and Adenosine Triphosphate Levels in *Bacillus popilliae* and *Bacillus thuringiensis*

Allan A. Yousten,¹ R. S. Hanson,² Lee A. Bulla, Jr., and Grant St. Julian

(¹Virginia Polytechnic Institute and State University, Blacksburg; ²University of Wisconsin, Madison)
Can. J. Microbiol. 20(12): 1729-1734. December 1974

Six tricarboxylic acid cycle enzymes were assayed in cell-free extracts of *Bacillus popilliae* and *B. thuringiensis* at various times during early and later stationary phases of growth. In *B. popilliae*, low levels of citrate synthase and isocitric dehydrogenase were present at all times. After exponential growth was complete, adenosine triphosphate (ATP) levels in *B. popilliae* cells fell more than 100-fold and the cells failed to sporulate. Supplementation with glucose reestablished high ATP levels but did not allow sporulation. When post-exponential cells of *B. popilliae* were resuspended in glucose-supplemented spent broth, prepared from a sporogenous strain of *B. subtilis*, sporulation did not occur. This technique had previously been successful in allowing sporulation of tricarboxylic acid cycle mutants of *B. subtilis*. In contrast, *B. thuringiensis* tricarboxylic acid cycle enzymes increased in activity after exponential growth was complete, ATP levels remained high, and almost all cells in the population underwent sporulation.

3636 • Starch and Amylose Degradation by ^{60}Co γ -Irradiation

B. T. Hofreiter

J. Polym. Sci., Polym. Chem. Ed. 12(12): 2755-2766.

December 1974

The effects of γ -irradiation (0.02-4.0 Mrads absorbed dose and 1.2 Mrads/hour dose rate) on depolymerization and selected physical properties of dry corn starch and amylose (both solid and solution forms) were investigated under conditions used to make graft polymers. Radiation introduces an alkali-sensitive structure, most likely *beta*-alkoxycarbonyl, having a G (scission) value of 2.8. A dimethyl sulfoxide (DMSO)-acetic acid-water solvent for intrinsic viscosity was developed that degraded irradiated amylose less than did aqueous 90% DMSO. The G value of 1.3 for solid amylose irradiated at 0° C. under nitrogen is lower than most literature values for either amylose or other polysaccharides. The protection of amylose against irradiation degradation in water by additions of DMSO is noteworthy. The G for amylose irradiated in 99.8% DMSO is 2.3; whereas, in water it is 30.

3637 • Two Diastereoisomeric 2,3:5,6-Di-*O*-Ethyldene- β -D-Alloses and Related Derivatives

William E. Dick, Jr. and David Weisleder

Carbohydr. Res. 39(1): 87-96. January 1975

Direct condensation of β -D-allose with acetaldehyde in the presence of sulfuric acid formed two of eight possible 2,3:5,6-di-*O*-ethyldene-D-alloses in overall yields of 84-96%. Conditions of the reaction were varied to favor formation of either isomer. The presence of a furanose ring in both isomers was established by converting the diastereoisomers to 1,4-di-*O*-acetyl-D-allitol analogs. Proton magnetic resonance analysis of the reducing isomers; their 1-*O*-acetyl derivatives; and a common hydrolysis product, 1,5,6-tri-*O*-acetyl-2,3-*O*-ethyldene-D-allose, established the configuration of D-allose as β -, and that the C-2' is fixed as *R* in the 2,3-*O*-ethyldene ring and as either *R* or *S* in the 5,6-*O*-ethyldene ring.

3638 • Fortification of Dry Soybean-Based Foods with DL-Methionine

G. N. Bookwalter, K. Warner, R. A. Anderson, G. C. Mustakas, and E. L. Griffin, Jr.

J. Food Sci. 40(2): 266-270. March-April 1975

The addition of small amounts of DL-methionine enhanced the nutritional value of soy foods as determined by protein efficiency ratios. Regular CSM (corn-soy-milk), instant CSM (both unsweetened and sweetened), soy beverage base and full-fat soy flour were formulated to contain up to 106 mg. DL-methionine per gram nitrogen. The products were stored at

25, 37, and 49° C. for up to 12 months. Fortified full-fat soy flour received slightly lower flavor scores than its unfortified control after storage for 2 months at 49° C. and for 6 months at 37° C. Fortified soy beverage base received lower flavor scores than its unfortified control in some tests, but differences were slight. Although slight flavor differences occurred during storage of fortified formulations containing soy protein, all flavor scores were satisfactory. As indicated by peroxide values and levels of free fatty acids, fat stability was unaffected by the presence of DL-methionine. Retention of DL-methionine was also satisfactory under the test conditions.

3639 • Apparent Odor Thresholds of Polyamines in Water and 2% Soybean Flour Dispersions

L. C. Wang, B. W. Thomas, K. Warner, W. J. Wolf, and
W. F. Kwolek¹

(¹Biometrician, North Central Region, ARS, USDA, Peoria, Ill.)
J. Food Sci. 40(2): 274-276. March-April 1975

Apparent odor thresholds of putrescine, cadaverine, spermidine, and spermine were determined in water and in 2% soybean flour dispersions. In neutral aqueous solutions respective apparent odor thresholds for putrescine, spermine, spermidine, and cadaverine were 22, 24, 129, and 190 p.p.m. In 2% soybean flour dispersions, the odor thresholds of putrescine and spermidine increased five- to tenfold; evidently, soybean flour masks odors of the polyamines. Because polyamines are present in soybeans at levels lower than thresholds, their contribution of characteristic amine odor to soybean products may be negligible.

3640 • Linseed vs. Latex. Two-Year Exposure Study

L. H. Princen

Paint Varn. Prod. 64(11): 24-29. November 1974

Many facts and myths alike prevail about the merits and disadvantages of both solvent- and water-based paints for outdoor use. Often we lose track of what is fact and what is fiction. To help discriminate and differentiate, an exposure series was started with 19 commercial and experimental paints. The careful and frequent observations made on these paints during the first 2 years of exposure reveal that excellent coatings can be formulated from any type of binder, if the best materials and technical know-how are applied. Material resources and consumer demands, however, will largely determine the direction that the exterior paint trade will take in the future.

3641 • Grain Preservatives: Effect on Aflatoxin and Ochratoxin Production

E. E. Vandegraft, C. W. Hesselton, and O. L. Shotwell
Cereal Chem. 52(1): 79-84. January-February 1975

Corn was treated with either 2% ammonia or 1% propionic acid. Both ammonia and propionic acid significantly reduced mold growth and subsequent aflatoxin and ochratoxin formation. Growth and the formation of mycotoxins were inhibited more by propionic acid than by ammonia. Both ammonia and propionic acid remained effective in inhibiting mold growth and aflatoxin production and in preventing ochratoxin production when treated corn stood as long as 19 and 29 weeks before inoculation.

3642 • Biological Threshold Levels of Soybean Trypsin Inhibitors by Rat Bioassay

J. J. Rackis, J. E. McGhee, and A. N. Booth¹
(¹Western Regional Research Laboratory, ARS, USDA,
Berkeley, Calif.)

Cereal Chem. 52(1): 85-92. January-February 1975

In conventional processing of soy flour by moist heat (toasting) an apparent destruction of at least 95% of the trypsin inhibitor (TI) is observed when assayed by various procedures. A more accurate and reproducible method, particularly suitable for determining TI activity of heat-processed samples, has been used in this study. Toasted soy flour has much greater TI activity when assayed by the modified procedure because it is now possible to measure the activity of insoluble TI. The destruction of TI activity in defatted soy flakes by live steam at 100° C. was determined by the modified procedure. Samples containing graded levels of TI activity were fed to rats. As TI activity decreased, weight gain, protein efficiency ratio, and nitrogen digestibility rapidly increased and pancreatic hypertrophy decreased. The adverse effects of raw meal as measured by these four biological parameters disappeared at different levels of TI activity in the diet. No pancreatic hypertrophy occurred in rats fed soy flour in which only 55 to 69% of TI activity had been destroyed. Maximum body weight, protein efficiency values, and nitrogen digestibility were obtained with rats fed soy samples in which 79 to 87% of the inhibitors were inactivated. Additional heat treatment did not further improve nutritive value. Our data do not support claims that residual TI in properly processed soy flour has antinutritional properties.

- 3643 • High Performance Liquid Chromatography of Fatty Methyl Esters: Analytical Separations
C. R. Scholfield
J. Am. Oil Chem. Soc. 52(2): 36-37. February 1975

Fatty methyl esters are separated on the basis of unsaturation and chain length on an analytical scale by high performance liquid chromatography with a C18/Corasil column and aqueous acetonitrile solvent. Analysis by this method includes polymerized and oxidized esters which may not be detected by gas chromatography.

- 3644 • Nomenclature of Alcohols and Simple Esters
Henry Rakoff
J. Am. Oil Chem. Soc. 52(2): 65A-66A. February 1975

The Subcommittee on Nomenclature of the American Oil Chemists' Society has undertaken the task of defining nomenclature as related to the chemistry of fats and oils.

- 3645* • Woody Core Fiber Length, Cellulose Percentage, and Yield Components of Kenaf
W. C. Adamson¹ and M. O. Bagby
(¹U.S. Plant Introduction Station, ARS, USDA, Savannah, Ga.)
Agron. J. 67(1): 57-59. January-February 1975

If kenaf lines differ in woody core fiber length and cellulose content, it may be possible to increase the pulp quality of kenaf through breeding. Forty-eight cultivars, breeding lines, and accessions of cultivated kenaf (*Hibiscus cannabinus* L.) were analyzed for differences in woody core fiber length and monoethanolamine (MEA) cellulose, yield, and plant size. All commercial cultivars of kenaf in the test had relatively short woody core fibers. In the breeding line with the longest woody core fibers, such fibers averaged 0.19 mm. longer than those of the longest-fibered cultivar, a significant difference. Mean woody core fiber length showed negative correlations with yield, plant height, stalk diameter, and MEA cellulose.

Kenaf lines and cultivars did not vary greatly in MEA cellulose, and the commercial cultivars were near the middle of the range. MEA cellulose showed positive correlations with stalk diameter and plant height.

- 3646 • Graft Copolymers from Cobalt-60 Preirradiated Starch and Mixtures of Acrylamide with *N,N,N*-Trimethylaminoethyl Methacrylate Methyl Sulfate
George F. Fanta, Robert C. Burr, W. M. Doane, and C. R. Russell
J. Polym. Sci., Polym. Symp. 45: 89-97. 1974

Starch was preirradiated with cobalt-60 and then allowed to react with mixtures of acrylamide and *N,N,N*-trimethylaminoethyl methacrylate methyl sulfate (TMAEMA·MS) in a water solution. The graft copolymers resulting were purified and characterized, and the influence was determined of a number of irradiation and reaction variables on graft copolymer composition. Although the reaction of irradiated starch with monomers must be carried out with a monomer solution purged with nitrogen to remove dissolved oxygen, a nitrogen atmosphere over the starch sample during irradiation is not necessary to achieve graft polymerization. With monomer mixtures containing 2, 5, 10, 15, and 50 mole-% TMAEMA·MS, the mole percentage of TMAEMA·MS in grafted branches was less than that in the initial monomer mixture, whereas ungrafted polymer generally contained a higher percentage of the cationic monomer than was present initially. A tenfold variation in irradiation dose (0.5-5.0 Mrad) caused only small variations in percent add-on; however, intrinsic viscosities of grafted branches decreased with increasing irradiation dose. Substituting aqueous ethylene glycol for water as the reaction medium produced more frequent grafts of lower molecular weight. Graft polymerization onto partially degraded starches gave graft copolymers with better water solubility.

- 3647 • Hydrolyzed Starch-Polyacrylonitrile Graft Copolymer Solutions: Effect of Shear History on Transient and Steady-State Viscoelastic Behavior
E. B. Bagley and N. W. Taylor
J. Polym. Sci., Polym. Symp. 45: 185-196. 1974

Both viscosity η and primary normal stress difference ($P_{11}-P_{22}$) of water solutions of hydrolyzed starch-polyacrylonitrile graft copolymers have been investigated, with a cone and plate rheometer, as a function of time and sample history at a variety of shear rates. At a constant shear rate the highly viscoelastic fluids show strong stress overshoot effects, both η and ($P_{11}-P_{22}$) rising to a maximum and then falling to a steady-state value. Both equilibrium levels and peak heights strongly depend on sample history. Unexpectedly, oscillatory shearing of certain samples at low frequency and amplitude, before steady shearing at constant shear rate, had an extreme effect on observed peak heights of both η and ($P_{11}-P_{22}$) but little on equilibrium levels. Magnitude of the effect depends on the time for which the oscillations are imposed. Such behavior may be characteristic of some high molecular weight polymers in solution and useful in identifying long-range entanglements which strongly influence the elastic properties of these solutions.

- 3648 • Applications of Extracellular Microbial Polysaccharide-Polyelectrolytes: Review of Literature, Including Patents
Allene Jeanes
J. Polym. Sci., Polym. Symp. 45: 209-227. 1974

Hydrophilic macromolecular polysaccharides, selected for their distinctive constitution and unusual properties, are produced industrially from common sugars by nonpathogenic microorganisms. The α -(1 \rightarrow 6)-linked D-glucan dextran and fractions of defined lower molecular weight produced from it are derivatized chemically to a variety of ionogenic substances for uses such as: anticoagulant, antilipemic, and peptic-ulcer alleviating agents; to enhance the sensitivity and covering power of x-ray and photographic emulsions; and separations of sensitive biochemical products by two-phase liquid distribution and ion-exchange and affinity chromatography. The polyanionic heteropolysaccharide xanthan is used in many industries (such as agriculture, abrasives, ceramics, food, paint, petroleum production, and textile) for its thickening and suspending ability even in the presence of high salt concentrations, reversible shear thinning, synergistic interaction with galactomannans, and excellent stability to heat and to acidic and basic conditions. Other water-soluble polysaccharide-polyelectrolytes, produced in liquid cultures unattached to the microbial cells, have potentially useful properties.

- 3649 • Coatings from Partially Epoxidized Linseed Oil with Hydroxybutadiene and Styrene-Maleic Anhydride Resins
T. H. Kho and L. E. Gast
J. Paint Technol. 47(601): 41-45. February 1975

Partially epoxidized linseed oils with various oxirane contents were reacted with low-molecular-weight, hydroxybutadiene polymers and copolymers and with partially esterified styrene-maleic anhydride resins to form higher molecular-weight coatings. The products were evaluated for their air-dried and baked film properties. Air-dried films were light colored and possessed high gloss. Almost all the films showed excellent hardness and chemical resistance. Impact resistance of the films varied with composition of the coating resins, ranging from 160 to 20 inches per pound. These coatings, made with easily prepared epoxidized linseed oil, should be attractive to coatings manufacturers.

- 3650 • Publications and Patents of the Northern Regional Research Laboratory, July-December 1974
North. Reg. Res. Lab., ARS, USDA, 58 pp. [February 1975]

- 3651* • Corn Starch Compound Recovers Metals from Water
R. E. Wing
Ind. Wastes (Chicago) 21(1): 26-27. January-February 1975

Insoluble starch xanthate offers industry a new way to remove and recover heavy metals dissolved in water. Recovering expensive metals at the industrial plants where they are used permits their reuse, conserves them as limited natural resources, and reduces dangers of toxic levels in public water supplies and city sewage sludge.

- 3652 • *Actinomycetales* from Corn
A. J. Lyons, T. G. Pridham, and R. F. Rogers
Appl. Microbiol. 29(2): 246-249. February 1975

Mesophilic *Actinomycetales* were isolated from whole corn, brewer's grits, and break flour received from three different mills and also were identified by two taxonomic systems. In addition, strains were isolated from high-moisture (27%) field corn; high-moisture silo-stored corn (untreated); and high-moisture corn treated with ammonia, ammonium isobutyrate, or propionic-acetic acid. According to standard techniques, 139 strains were extensively characterized and 207 additional strains were partially characterized. On the basis of these characterizations, the streptomycete strains were identified by both systems of Pridham et al. and of Hütter because these systems are rapid and accurate. In general, only *Streptomyces griseus* (Krainsky) Waksman and Henrici was isolated from high-moisture whole corn (treated or untreated) except from grain exposed to ammonium isobutyrate. Strains isolated from high-moisture corn subjected to that treatment represented both *S. griseus* and *S. albus* (Rossi Doria) Waksman and Henrici. The strains isolated from corn and corn products from the three mills were identified with a number of streptomycete species. Of all *Actinomycetales* isolated, only three were not streptomycetes--two from brewer's grits and one from break flour.

- 3653* • Absolute Configuration of 2,3-Dihydroxy-2-isopentylbutanedioic Acid, A Component of the Alkaloid Isoharringtonine
Svante Brandänge,¹ Staffan Josephson,¹ Staffan Vallen,¹
and Richard G. Powell
(¹Arrhenius Laboratory, University of Stockholm, Stockholm,
Sweden)
Acta Chem. Scand. Ser. B 28(10): 1237-1238. 1974

A study of the circular dichroism spectrum of a molybdate complex of the title acid has given, for the first time, the exact positions of all atoms in the molecule (absolute configuration). Isoharringtonine alkaloid, from which the acid is obtained, exhibits significant activity against experimental leukemia.

- 3654 • Structure of the Alcohols Derived from Wax Esters in Jojoba Oil
Richard J. Hamilton,¹ M. Yaquob Raie,¹ and Thomas K. Miwa
(¹The Polytechnic, Liverpool, England)
Chem. Phys. Lipids 14(1): 92-96. February 1975

The monounsaturated C₁₈-C₂₄ alcohols obtained by saponification of the wax esters of jojoba oil have been separated and the double bond positional isomers determined by a modified von Rudloff oxidation technique. The major homologue of each chain length has the double bond at the w9 position suggesting a close biogenetic relationship between these major components. The relationship is much less apparent in the minor components.

- 3655 • Corn Quality as Influenced by Harvest and Drying Conditions
A. J. Peplinski, O. L. Brekke, E. L. Griffin, G. Hall,¹
and L. D. Hill¹
(¹University of Illinois, Urbana)
Cereal Foods World 20(3): 145-149, 154. March 1975

Recent mechanization has resulted in corn being harvested and dried under a variety of conditions that affect its quality. The overall effect of harvest moisture, sheller damage, and drying temperature on given samples was explored. Corn (1971 crop) was harvested at moisture contents about 17, 20, 25, and 32% and at sheller settings that produced low or high kernel damage. Corn was conditioned by either natural-field drying or artificial drying with air at temperatures ranging from ambient to 300° F. in an experimental fluidized-bed batch dryer. Market grade of the cleaned corn varied from U.S. No. 1 to Sample Grade. Bushel test weight, damaged

kernels, kernel hardness, germination, stress crack formation, kernel breakage, and screening amounts were all influenced, to a degree, by the harvest and drying variables. There was little effect on corn chemical composition over the range of harvest and drying conditions studied. On the basis of quality evaluations made on the dried corn and of the conditions studied, harvest moisture should be 25% or less; shelling should be done with as little damage to kernels as possible, and drying may be conducted at air temperatures up to 180° F., but preferably less.

- 3656 • Comparison of Three Atomic Absorption Techniques for Determining Metals in Soybean Oil
L. T. Black
J. Am. Oil Chem. Soc. 52(3): 88-91. March 1975

Three different atomic absorption techniques were used to analyze metals contained in three different crude soybean oils. In the first, oil was decomposed by charring followed by high-temperature dry ashing. The ash was then dissolved in a dilute acidic aqueous medium. In the second, oil diluted with methyl isobutyl ketone as the solvent was directly aspirated. In the third, the original oil sample was ashed and the metal atomized in a sequential process by a carbon rod furnace. This third technique required only microliter quantities of an oil. The analysis for many metals was similar regardless of the technique. However, values obtained for zinc, cadmium, chromium, lead, and calcium were extremely dependent on the technique used.

- 3657 • *Carduus nigrescens* Seed Oil--A Rich Source of Pentacyclic Triterpenoids
R. V. Madrigal, R. D. Plattner, and C. R. Smith, Jr.
Lipids 10(3): 208-213. March 1975

Pentacyclic triterpene alcohols (3%), their acetates (18%), and their long-chain fatty acid esters (11%), together with triterpene acids (18%), represent about 50% of the oil from seed and pericarp of the thistle *Carduus nigrescens* Vill. (Compositae). Along with the usual fatty acids, alkaline hydrolysis of this oil gave triterpene alcohols, some of which were identified by gas chromatography-mass spectrometry. Composition of the triterpenoid fraction, as indicated by gas chromatography of the corresponding acetates, was: α -amyrin (6%), β -amyrin (15%), lupeol plus Ψ -taraxasterol (3%), erythrodiol (6%), and oleanolic acid (3%). Several components, representing 16% of the oil, were not identified. The content of pentacyclic triterpenoids is the largest found in plant seed oils.

- 3658 • Decomposition of Linoleic Acid Hydroperoxides. Enzymic Reactions Compared with Nonenzymic
Harold W. Gardner
J. Agric. Food Chem. 23(2): 129-136. March-April 1975

In biological tissue, linoleic and linolenic acid hydroperoxides are decomposed primarily by the following pathways: (1) reduction (or nucleophilic reactions), (2) isomerization by linoleic acid-hydroperoxide isomerase, (3) epoxidation by flour-water suspensions, (4) vinyl ether formation, (5) anaerobic lipoxygenase reactions, and (6) production of volatile aldehydes. In these reactions enzymes are probably involved.

Decomposition of fatty acid hydroperoxides (or their esters) by nonenzymic reactions occurs by both heterolytic and homolytic mechanisms. Although heterolytic reactions are not restricted to production of the corresponding hydroxy fatty acid from the hydroperoxide, reportedly it is the major reaction. Homolytic decompositions are much more complex, and the products often depend upon the conditions used. Presumably hydroperoxides homolytically decompose mainly through formation of peroxy or alkoxy radicals. Recent studies on systems which should promote alkoxy radical formation indicated that the major reaction pathways are: (1) dimer formation from termination reactions, (2) loss or gain of a hydrogen radical, (3) cyclization of the alkoxy radical to the α -unsaturation, and (4) 1,4-addition to the conjugated diene.

- 3659 • Lipoxygenase and Flavor of Soybean Protein Products
Walter J. Wolf
J. Agric. Food Chem. 23(2): 136-141. March-April 1975

Work of the past 10 years indicates that lipids are a major source of compounds responsible for objectionable flavors in soybean protein products. Lipoxygenase is an important factor in the generation of flavor compounds from the lipids when soybeans are processed under high moisture conditions as in the preparation of soy milk by the traditional process. Less certain is the significance of lipoxygenase action when soybeans are processed under low moisture conditions as in the commercial extraction of oil. However, the potency of the flavor compounds that can arise by decomposition of hydroperoxides generated by lipoxygenase suggests that very little oxidation may be needed to give rise to objectionable levels of flavor constituents. Consequently, lipoxygenase cannot be ruled out as a causative factor until further work clearly demonstrates that lipoxygenase catalysis is not occurring at low moisture levels. High temperature is the key step currently proposed for inactivation of lipoxygenase during processing of soybeans: (a) grinding with hot water; (b) dry heating-extrusion cooking; (c) blanching; and (d) grinding at low pH followed by cooking. Products from such processes have improved flavor, but may lack functionality because of poor

protein solubility caused by heat treatment. An alternative approach is to extract the flavor components after they are formed with hexane-ethanol or hexane-2-propanol. Relatively little denaturation of the proteins occurs with these extraction solvents.

3660 • Direct Estimation of Lysine in Corn Meals by the Ninhydrin Color Reaction

Alfred C. Beckwith, Jerrold W. Paulis, and Joseph S. Wall
J. Agric. Food Chem. 23(2): 194-196. March-April 1975

The colored derivative produced by the reaction of ninhydrin with α - and ϵ -amino groups on amino acids, peptides, and proteins is the basis for a rapid spectrophotometric estimation of lysine in corn meals. If the meal is first extracted with trichloroacetic acid to remove free amino acids, the amount of colored ninhydrin derivative produced in a dimethyl sulfoxide solvent system can be used as a quantitative determination of lysine content to within the uncertainty found by amino acid analyses for lysine. The method has advantages of simplicity, rapidity, and economy; requires but small samples of meal (10-20 mg.); and is highly useful in the screening of corn in breeding programs for high-lysine grains.

3661 • Corn Protein Subunits: Molecular Weights Determined by Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis

Jerrold W. Paulis, Jerold A. Bietz, and Joseph S. Wall
J. Agric. Food Chem. 23(2): 197-201. March-April 1975

Reduced corn endosperm proteins or their subunits were resolved and molecular weights determined by sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). Heterogeneity, poor solubility, and molecular interactions make characterization of these proteins difficult by other methods. Albumins, globulins, and zein were extracted from endosperm meal by a modified Osborne-Mendel procedure. Then alcohol-soluble glutelin (ASG) was extracted with 70% ethanol-0.5% sodium acetate-0.1 M β -mercaptoethanol (β -ME), and alcohol-insoluble glutelin (AIG) was extracted with pH 8.9 Tris-borate buffer containing SDS and ME. Albumins and globulins were very heterogeneous and differed in polypeptide composition. Zein polypeptides, however, were homogeneous in mol.wt. (21,300). ASG contained primarily 24,700 mol.wt. subunits and differed uniquely from zein and from the heterogeneous AIG. ASG and AIG corresponded in polypeptide composition and mol.wt to glutelin subunit fractions prepared from destarched residues and isolated on Sephadex G-200. Comparison of polypeptides of each protein class from normal corn endosperm to corresponding protein fractions from near-isogenic high-lysine *opaque-2* and *floury-2* endosperms revealed some quantitative differences. Thus, SDS-PAGE is useful for characterizing, comparing, and differentiating corn endosperm proteins in protein isolation studies and genetic investigations.

- 3662 • Ammonium Hydroxide Treatment of Aflatoxin B₁. Some Chemical Characteristics and Biological Effects
Ronald F. Vesonder, Alfred C. Beckwith, Alex Ciegler,
and Robert J. Dimler
J. Agric. Food Chem. 23(2): 242-243. March-April 1975

When a mixture of aflatoxin B₁ and ammonium hydroxide is stirred at room temperature for 21 hours, aflatoxin B₁ is obtained after acidification and chloroform extraction. When a similar reaction mixture is stirred at room temperature for 8, 10, 11, 14, and 18 days, drying on a rotary evaporator at 60° yields a brown product, which upon acetone extraction gives a mixture of substituted *o*-coumaric acid and aflatoxin B₁ as evidenced by infrared and ultraviolet spectroscopy. The brown residue was nontoxic in a chick embryo bioassay.

- 3663 • The Effect of Various Extractants on the Subunit Composition and Associations of Wheat Glutenin
J. A. Bietz and J. S. Wall
Cereal Chem. 52(2): 145-155. March-April 1975

Wheat flours were extracted sequentially with 0.04M NaCl, 70% ethanol, 0.1N acetic acid (HOAc), 0.01N acetic acid-0.2mM, HgCl₂ (HgCl₂), and 0.1N acetic acid-0.1% 2-mercaptoethanol (ME). The distribution of nitrogen in each extract was determined, and subunit compositions were examined by sodium dodecyl sulfate-polyacrylamide gel electrophoresis. Glutenins, found in the HOAc, HgCl₂, and ME extracts, differed significantly in sub-unit composition for each variety; thus glutenin is heterogeneous and can be partially fractionated by different solvents. The HOAc and HgCl₂ extracts, upon further fractionation in neutral 70% ethanol, were found to contain 30 to 51% gliadinlike proteins. Carefully defined conditions, including a precipitation step, must be used if purified glutenin is to be isolated from flour extracts.

- 3664 • Cleaning Trials for Corn Containing Aflatoxin
O. L. Brekke, A. J. Peplinski, and E. L. Griffin, Jr.
Cereal Chem. 52(2): 198-204. March-April 1975

Physical separation methods were generally ineffective for lowering the aflatoxin content of naturally contaminated corn used in the experimental work. The corn lots tested differed in aflatoxin content (10 to 450 p.p.b. B₁), geographic source, content of broken corn-foreign material, and represented both white and yellow corn. Dry cleaning, wet cleaning, density separation, and preferential fragmentation of the grain were used in the

laboratory tests. Aflatoxin was concentrated in broken corn-foreign material in only one of the ten lots tested. Hand-selected kernels that outwardly appeared sound and free of the bright greenish-yellow fluorescence associated with presence of aflatoxin had the toxin in excess of current guidelines (20 p.p.b.) in six out of seven lots of corn. The hand-selected kernels contained about one-half to as little as one-tenth the level of aflatoxin in the unfractionated lot.

- 3665 • Pilot-Plant Dry Milling of Corn Containing Aflatoxin
O. L. Brekke, A. J. Peplinski, G. E. N. Nelson, and
E. L. Griffin, Jr.
Cereal Chem. 52(2): 205-211. March-April 1975

Three lots of corn (one yellow, two white) naturally contaminated with different levels of aflatoxin (13, 160, and 510 p.p.b. of B₁) were dry-milled to determine distribution of the toxin among product fractions. No problems were encountered in the milling steps. Product yields and fat contents were fairly typical of those for a normal dent corn. Aflatoxin level was always lowest in the grits and highest in the germ, hull, or degermer fines, and varied with the contamination level of corn being milled. Proportion of aflatoxin B₁ in the prime product mix (i.e., grits, low-fat meal, and low-fat flour) amounted to only 7 to 10% of total quantity of B₁ in all products. Concentrations of aflatoxin in degermer fines, germ, and hull exceeded that of the corn milled. Aflatoxin B₁ level in endosperm-derived products correlated with their fat content. Yield of prime product mix, based on all products recovered, varied between 49 and 60% in these tests.

- 3666 • Hydroxyl Reactivity--A Kinetic Approach is Needed
Jacob Lehrfeld
Carbohydr. Res. 39(2): 364-367. February 1975

The relative reactivity of hydroxyl groups has been determined previously from product isolation data. A kinetic analysis of the reaction between methyl 4,6-O-benzylidene- β -D-glucopyranoside and acetic anhydride in pyridine demonstrated that this approach can lead to erroneous conclusions.

3667 • Preservation of High-Moisture Corn: A Microbiological Evaluation

R. J. Bothast, G. H. Adams,¹ E. E. Hatfield,¹ and
E. B. Lancaster

(¹University of Illinois, Urbana)

J. Dairy Sci. 58(3): 386-391. March 1975

Ammonia, ammonium isobutyrate, isobutyric acid, and propionic-acetic acid at concentrations of 0.5%, 1.75%, 1.5%, and 1.2%, respectively, were applied to comparable 1,500-bushel lots of freshly harvested yellow dent corn having a moisture content of 27%. Treated corn was stored in partially open wooden bins. Harvestore® and barrel storage of untreated corn were included as controls. Temperature and microbiological changes were evaluated throughout 6 months of storage. As the corn came from the field, log counts of 6.3, 5.8, 5.3, and 3.0 per gram were determined for bacteria, molds, yeasts, and actinomycetes, respectively. All chemicals immediately reduced bacterial and actinomycete counts and eliminated molds and yeasts. All treatments after approximately 30 days of storage had secondary fungal growth. *Scopulariopsis brevicaulis* predominated on ammonia-treated corn; *Mucorales*, and species of *Monascus*, *Penicillium*, *Fusarium*, and *Aspergillus flavus*, as well as *A. fumigatus*, were in ammonium isobutyrate-treated corn. *A. flavus* was the predominant mold infecting isobutyric acid and propionic-acetic acid treated corn late in storage.

3668 • Solid-Substrate Fermentor for Ochratoxin A Production

L. A. Lindenfelser and A. Ciegler

Appl. Microbiol. 29(3): 323-327. March 1975

A laboratory-scale fermentor designed for solid-substrate fermentation was constructed and tested. Its capacity to produce ochratoxin under varied conditions was determined with wheat as the substrate. Ochratoxin yields of 2,000 to 2,500 µg./g. of wheat were regularly obtained and, occasionally, yields as high as 4,000 µg./g. were obtained. The most critical factor in the fermentation was initial substrate moisture content; wheat tempered at 30 to 31% moisture produced the highest yields. Other variables tested were agitation and aeration rates, initial static culture time, and inoculum types and volumes.

3669 • Processing Soybeans into Foods: Selected Aspects of Nutrition and Flavor

J. J. Rackis, J. E. McGhee, D. H. Honig, and A. N. Booth¹

(¹Western Regional Research Laboratory, ARS, USDA, Berkeley, Calif.)

J. Am. Oil Chem. Soc. 52(4): 249A-253A. April 1975

Since many new soy protein products are being developed that differ in enzyme activity, protein dispersibility, flavor, nutritive value, and functional properties, quality control becomes increasingly significant. The effects of dry and moist heat and hexane:ethanol azeotrope extraction upon various enzymatic activities, protein solubility, and nutritive value of defatted soy flakes differ considerably. Specifications and guidelines initially developed to establish the degree of moist heat treatment required to produce edible-grade products need to be reevaluated for these processes. Flavor scores of hexane:ethanol azeotrope-extracted flakes and proteinates prepared from them are significantly higher than those prepared by current commercial practices. Because peroxidase is a much more stable enzyme than lipoxygenase, determination of peroxidase activity may be a more suitable method to define proper processing conditions which improve the flavor of soy products. A combination of hexane:ethanol extraction and steaming improves the flavor and nutritive value of defatted soy flakes. Azeotrope extraction alone does not inactivate trypsin inhibitors; nutritive value of the extracted flakes is low, and pancreatic hypertrophy occurs when they are fed to rats. Protein efficiency ratio of the processed flakes is 2.2 on a basis of a value = 2.5 for casein. Other factors to be considered in preparing soy protein isolates of good nutritional quality are: choline deficiency, variability in sulfur amino acid content, and formation of phytate complexes that affect bioavailability of essential minerals, particularly zinc.

3670 • Mycotoxins: Occurrence, Chemistry, Biological Activity

Alex Ciegler

Lloydia 38(1): 21-35. January-February 1975

The mycotoxin problem in cereals and other commodities is reviewed. Four families of mycotoxins--aflatoxins, trichothecenes, tremorgens, and zearalenone--are discussed in more detail with emphasis being placed on their occurrence, chemistry, and biological activity.

3671 • Scanning Electron Microscopy of Ascospores of *Debaryomyces* and *Saccharomyces*

C. P. Kurtzman, M. J. Smiley, and F. L. Baker

Mycopathologia 55(1): 29-34. February 1975

Ascospores from species of *Debaryomyces* and the *Torulaspora*-group of *Saccharomyces* were examined by scanning electron microscopy. Ornamentation on ascospores of *D. hansenii* varied from short to long interconnected ridges or broad-based, elongated conical protuberances. A spiral ridge system was detected on the ascospores of *D. marana*, but wartlike

protuberances occurred on those of *D. cantarellii*, *D. castellii*, *D. coudertii*, *D. formicarius*, *D. phaffii*, *D. vanriji*, and *D. yarrowii*. Ascospores of *D. halotolerans* did not have protuberances, and the species appears to be identical with *Pichia farinosa*. Wartlike protuberances also were found on ascospores of *S. delbrueckii*, *S. microellipsoidea*, *S. rosei*, *S. inconspicuus*, *S. fermentati*, *S. montanus*, and *S. vafer*, but the ascospore surface of *S. pretoriensis* was covered by fine ridges. Short tapered ridges covered the ascospores of *S. kloeckerianus*.

- 3672 • Fungi and Aflatoxin in a Bin of Stored White Maize
E. B. Lillehoj, D. I. Fennell, and S. Hara¹
(¹Research Institute of Brewing, Tokyo, Japan)
J. Stored Prod. Res. 11(1): 47-51. March 1975

Samples of maize from discolored spots in the surface layer of stored grain in a southeast Missouri bin were examined for variation in microbial profile and for the presence of aflatoxin. Comparisons were made with samples of nondiscolored maize from the same bin. Deteriorated test kernels showed a high incidence of *Penicillium*, *Absidia*, *Mucor*, *Rhizopus*, and *Fusarium* spp., as well as bacteria and yeasts. *Aspergillus* species were also frequently observed; *A. flavus* was the most common species in this group. In one sample of discolored maize 80% of the kernels contained *A. flavus* and the sample had 0.40 p.p.m. aflatoxin B₁. Other fractions exhibited extensive discoloration but no aflatoxin.

- 3673 • Isolation of a Pure Isomer of Linoleic Acid Hydroperoxide
H. W. Gardner
Lipids 10(4): 248-252. April 1975

A mixture of positional isomers of linoleic acid hydroperoxide was produced from the oxidation of linoleic acid by lipoxygenase from corn or soybean. Chromatography on a column of silicic acid separated 13-hydroperoxy-11,9-octadecadienoic acid in 99+% purity from the mixture obtained by soybean lipoxygenase oxidation of linoleic acid. Attempts at isolation of pure 9-hydroperoxy-10,12-octadecadienoic acid from hydroperoxides obtained by corn lipoxygenase oxygenation of linoleic acid were partially successful with isolation of the 9-hydroperoxide in 97% purity.

- 3674* • Agricultural Fibers in the Paper Industry
Dwight L. Miller and Ivan A. Wolff
In "Solid Wastes," ed. C. L. Mantell, chap. III.17,
pp. 525-544. New York. 1975

Nonwood agricultural fibers have served as papermaking raw materials for centuries. Many areas of the world are deficient in forest resources. Use of nonwood fibers are expected to increase and provide significant amounts of papermaking raw materials. Important nonwood fibers are represented by sugarcane bagasse, cereal straws, reeds, kenaf, bamboos, leaf fibers, and many others.

- 3675 • Ultrasonic Extraction of Proteins from Autoclaved Soybean Flakes
L. C. Wang
J. Food Sci. 40(3): 549-551. May-June 1975

Amounts of proteins extracted from soybean flakes were compared by applying ultrasonic waves and by conventional stirring. Respective yields of the total proteins from unautoclaved and autoclaved flakes were 60% and 16% by conventional stirring and 88% and 58% by sonication in a single 1:10 meal-to-water extraction. From autoclaved flakes sonication in a single extraction dispersed up to 78% total proteins in water with 1:40 meal-to-water ratio. Sonication recovered a portion of proteins from autoclaved flakes ordinarily unattainable by conventional stirring extraction. Proteins obtained by either method revealed no differences in their ultracentrifuge patterns.

- 3676 • Filler Crosslinking by Diisocyanate in a Starch Xanthide-Reinforced Elastomer
R. J. Dennenberg and E. B. Bagley
J. Appl. Polym. Sci. 19(2): 519-530. February 1975

Starch xanthide is an effective reinforcing agent for vulcanized elastomers. On prolonged exposure to water, however, the effectiveness of the starch xanthide as a reinforcing agent is greatly reduced. The xanthide crosslink density is too low to prevent plasticization of the filler by water. Treatment with diisocyanates introduces additional crosslinks into the filler, increases the modulus of the filler, and significantly improves the physical properties both of the dry vulcanizate and of the vulcanizate after a 70-hour water immersion test. Model systems showed that the diisocyanates cross-linked the starch filler and did not introduce starch-rubber or rubber-rubber crosslinks. Several diisocyanates worked satisfactorily in the final vulcanizate.

- 3677 • Insoluble Starch Xanthate: Use in Heavy Metal Removal
R. E. Wing, W. M. Doane, and C. R. Russell
J. Appl. Polym. Sci. 19(3): 847-854. March 1975

Water-insoluble starch xanthates were prepared by xanthation of highly crosslinked starches under various conditions. After isolation of the products by solvent dehydration, freeze drying, or spray drying, their properties were determined. These products were very effective in removing heavy metals from water.

- 3678 • Synergistic Color Variants of *Aureobasidium pullulans*
L. J. Wickerham and C. P. Kurtzman
Mycologia 67(2): 342-361. March-April 1975

Color variants of *Aureobasidium pullulans* were isolated from materials collected in tropical and subtropical regions of the world. Three different types of variants produce colonies that are either yellow, red, or purple. When the variants are either mixed with or grown near many different species of yeasts and other microfungi, the rapidity and intensity with which pigment is produced are markedly enhanced. Yellow variants are moderately unstable and change to red. The red variants are highly unstable, changing to yellow. Reversion to the normal wild type is seldom observed. Addition of acid or base causes the pigments to function as pH indicators. Pigment formation is temperature sensitive, and mixtures of variants and elicitor strains are colorless at 35° C., but they exhibit typical enhancement of pigmentation when removed to 25° C. Variants incubated alone at 35° C. show temporary intense pigmentation upon removal to 25° C.

- 3679 • Aflatoxin Occurrence in Some White Corn Under Loan, 1971:
IV. Mold Flora
C. W. Heseltine, R. J. Bothast, and Odette L. Shotwell
Mycologia 67(2): 392-408. March-April 1975

An extensive, as well as intensive, study was made of white corn under government loan as it was delivered in 1972 to the Agricultural Stabilization and Conservation Service at Diehlstadt, Missouri. The corn (450,000 bushels) from 77 loans had been stored on individual farms. From each of 1,283 trucks representative samples of corn were taken and ground for aflatoxin assay; a small portion was used to streak plates of yeast extract agar containing tetracycline. After incubation for 5 days at 28° C., the plates were read under a dissecting microscope for the common types of molds with special emphasis on the presence of the *Aspergillus flavus* group. A

rough estimation was made of the number of *A. flavus* colonies per plate. Other molds recorded were *A. niger*, *A. fumigatus*, *A. terreus*, *A. glaucus* group; *Trichoderma*, *Penicillium*, *Fusarium*, *Rhizopus*, *Mucor*, and *Absidia*. Of the 1,283 samples, each representing a truckload of corn, 394 contained aflatoxin, and of these, the *A. flavus* group was present in all but 6. The molds most common in the 1,283 samples were *Penicillium* sp. (94%), *Fusarium* (89%), *A. flavus* (82%), and *A. niger* (71%). *A. parasiticus* was seen in only 15. No correlations seemed to exist between the grade of corn and the presence of *A. flavus*. However with some molds, a higher percentage occurred in the poorer grades. When actual counts of *A. flavus* were made on corn from three loans, the occurrence of *A. flavus* closely paralleled the aflatoxin content of the corn samples.

3680* • Heavy Metal Removal from Wastewater with Starch Xanthate

R. E. Wing

Proc. 29th Ind. Waste Conf., May 7-9, 1974, Eng. Bull. Purdue Univ., Eng. Ext. Ser. No. 145, Part 1, pp. 348-356. [1975]

A water-insoluble starch xanthate offers industry a low-cost product that removes and recovers heavy metals from wastewater. The process is effective over a pH range from 3 to 11 and in the presence of from 0 to 10% salt. A contact time as short as 5 minutes is sufficient for good removal. A mild acid treatment releases the bound metal so that it can be recovered and reused. Practically all metals are reduced to levels below strict discharge limits.

3681 • Starch Xanthide Reinforced Styrene-Butadiene Rubber:

Compounding to Reduce Water Sensitivity

R. A. Buchanan, W. M. Doane, C. R. Russell, and W. F. Kwolek¹

(¹Biometrician, North Central Region, ARS, USDA, Peoria, Ill.)

J. Elastomers Plast. 7(2): 95-113. April 1975

Resorcinol-formaldehyde, aminosilane, pigments, and oil may be added to starch xanthide reinforced styrene-butadiene rubbers (SBR) to reduce their water sensitivity. Such starch xanthide reinforced SBR can be used in demanding applications involving water immersion or exposure to high humidity.

3682 • Injection Molding of Conventional Formulations Based on Starch-Encased Powdered Rubber

T. P. Abbott, C. James, W. M. Doane, and C. R. Russell
J. Elastomers Plast. 7(2): 114-132. April 1975

Powdered rubber, containing from 3 to 7 phr starch xanthide, was prepared by coagulation of a starch xanthate-latex mixture. Almost all general-purpose elastomers can be powdered by this method without grinding. Six industrial formulations were injection molded: tire tread, shoe sole, shoe heel, and mechanical goods based on powdered SBR, oeSBR, EBR, and NBR. Both machine operating conditions and screw design affect properties of an injection-molded specimen. Test specimens made with a specific screw, whose design causes mastication of the powdered rubber formulation as the shot is being prepared for injection, were compared to those made with a conventional feed screw.

3683 • Cold Table for Film Preparation

J. A. Stolp, R. L. Eissler, and L. H. Princen
J. Paint Technol. 47(603): 71-73. April 1975

A cold table has been designed and used successfully to prepare free films from low viscosity drying oils that would ordinarily retract from the substrate at room temperature. Surface temperatures as low as -17° C. can be maintained during film preparation and drying. Films will not retract if allowed to dry for 12 to 14 days at temperatures below -15° C. After additional drying at room temperature the films can be peeled from the low-energy fluorocarbon support sheet.

3684 • Calcium in Flocculence of *Saccharomyces cerevisiae*

Neil W. Taylor and William L. Orton
J. Inst. Brew. (London) 81(1): 53-57. January-February 1975

A quantitative method was adopted for measuring flocculation intensity of yeast photometrically. In three strongly flocculent strains of *Saccharomyces cerevisiae* examined, flocculation intensity depended on ionic strength of the medium, as well as on Ca concentration, and was maximum at about 0.01 ionic strength. At this optimum ionic strength, when free Ca concentration was varied in stabilized complexing systems, a transition occurred at about 10^{-8} M Ca between flocculent and nonflocculent states. At higher Ca concentrations, flocculation intensity was nearly constant. The observed transition is at much lower Ca levels than other effects noted in the literature.

3685 • Cationic and Nonionic Starch Graft Polymers for
Filler Retention

H. D. Heath, B. T. Hofreiter, A. J. Ernst, W. M. Doane,
G. E. Hamerstrand, and M. I. Schulte
Staerke 27(3): 76-82. March 1975

Graft co- and terpolymers were prepared by free radical polymerizations of vinyl monomers onto preirradiated starch by a prototype commercial process. Products with graft contents of up to 46%, by weight, were obtained by grafting acrylamide and quaternary amine-containing esters of methacrylic acid to starch. The graft polymers were evaluated on a pilot fourdrinier paper machine as filler retention aids and compared with several commercial flocculants. Drainage rate increased markedly with one of the starch graft polymers that was cationic. Since the number of starch graft polymers prepared was limited, the results reported, although excellent, are not necessarily optimal. Further studies are needed to establish the relationships of graft content and terpolymer compositions to retention and drainage.

3686 • Photolysis of Some Carbohydrate Dithiobis(thioformates)

Edward I. Stout, William M. Doane, Charles R. Russell,
and Lee B. Jones¹

(¹University of Arizona, Tucson)

J. Org. Chem. 40(9): 1331-1336. May 1975

The photolysis of several oxidatively coupled xanthates of model sugar compounds has been investigated. The photolysis of bis(1,2:3,4-di-O-isopropylidene- α -D-galactopyranose-6-yl) dithiobis(thioformate) (2) gave the xanthate ester, bis(6-deoxy-1,2:3,4-di-O-isopropylidene- α -D-galactopyranos-6-yl) 6-O,6'-S-dithiocarbonate (5) in 78% yield. In concentrated solutions, bis(1,2:3,4-di-O-isopropylidene- α -D-galactopyranos-6-yl) tetrathiobis(thioformate) (3) was produced along with 5. The photolysis of bis(1,2:5,6-di-O-isopropylidene- α -D-glucofuranos-3-yl) dithiobis(thioformate) (14) gave bis(3-deoxy-1,2:5,6-di-O-isopropylidene- α -D-glucofuranos-3-yl) 3-O,3'-S-dithiocarbonate (15), in which an oxygen atom on the sugar ring has been replaced with sulfur with retention of configuration. A cyclic mechanism in which either the excited thiocarbonyl sulfur or a sulfur of the disulfide linkage attacks the carbon giving a front side displacement of oxygen has been proposed to account for the observed results.

- 3687 • Reactions of Sulfonates with Sodium Ethylxanthate
 Donald Trimmell, Edward I. Stout, William M. Doane,
 and Charles R. Russell
J. Org. Chem. 40(9): 1337-1339. May 1975

Various 6-O-tosyl- and 6-O-mesyl- α -D-glucopyranosides were reacted with sodium ethyl xanthate in either water or organic solvents to give 6-ethoxythiocarbonyl-6-thio derivatives. Methyl 6-ethoxythiocarbonyl-6-thio- α -D-glucopyranoside on treatment with sodium hydroxide yielded the 6-thiol, which on oxidation gave the 6,6'-disulfide. Cyclohexyl tosylates were reacted with sodium ethyl xanthate to give *S*-cyclohexyl-6-ethyl dithiocarbonates. Although the reaction of 1,2:3,4-di-O-isopropylidene-6-O-tosyl- α -D-galactopyranose with sodium ethyl xanthate was negligible in solvents, in the dry state at 150° mainly bis(1,2:3,4-di-O-isopropylidene-6-deoxy- α -D-galactopyranose) 6,6'-sulfide resulted.

- 3688 • Action of Weak Bases upon Aflatoxin B₁ in Contact with Macromolecular Reactants
 Alfred C. Beckwith, Ronald F. Vesonder, and Alex Ciegler
J. Agric. Food Chem. 23(3): 582-587. May-June 1975

When treated with ammonia at 25°-50° C. for 3 to 30 days, radiolabeled aflatoxin B₁ added to corn grain flour binds covalently and preferentially to corn protein fractions and water-soluble components. In the presence of base, two types of associations can occur between aflatoxin and macromolecular substrate. A reversible association results from opening the lactone ring of the B₁ molecule in basic media and can lead to electrostatic or hydrogen bonding with substrate, or both. The irreversible or covalent interaction between B₁ and substrate does not visibly alter the spectral properties of the primary B₁ chromophore (365 nm absorbance). The affixation of this chromophore to much larger molecules in the presence of weak bases implicates the dihydrofurofuran ring system of B₁ as the site of B₁ interaction. A marked reduction of complete loss of toxicity in certain corn isolates containing the primary B₁ chromophore is further evidence indicating the difuran ring system to be the site of interaction.

- 3689 • The Preparation of Powdered EPDM Rubber from Solution
 R. E. Dixon and E. B. Bagley
J. Appl. Polym. Sci. 19(5): 1491-1493. May 1975

To produce a powdered EPDM rubber from a hexane solution the EPDM/hexane solution is emulsified first in aqueous starch xanthate. The organic solvent is then removed to yield a rubber latex dispersed in a starch xanthate solution. This mixture is coprecipitated by acid addition in the presence of sodium nitrite. After subsequent washing and drying, the product is a finely divided powdered EPDM rubber.

3690* • Starch-Based Plastics and Films

Felix H. Otey, Richard P. Westhoff, and Charles R. Russell
*In "Nonwoven Product Technology," Tech. Symp. sponsored by
Int. Nonwovens Disposables Assoc. (INDA), Miami Beach, Fla.,
March 11-12, 1975, pp. 40-47. 1975*

Techniques were developed for incorporating starch and starch-derived materials into resin formulations to yield films and disposable plastics. Benefits gained from using starch or starch products as part of composite or interpolymer systems include improved biodegradability, flame resistance, and reduction in the amount and cost of petroleum materials required. From the most promising resins--polyvinyl chloride, polyvinyl alcohol, and polyurethanes--plastics and thin films containing up to 60% starch and starch derivatives were prepared and evaluated.

3691* • The Importance of Aflatoxins in Grain Markets and Their Detection in the Laboratory and at the Elevator

Odette L. Shotwell
*In "Corn Quality in World Markets," ed. Lowell D. Hill (Dept.
Agr. Econ., Univ. Ill., Urbana), pp. 211-217. 1975*

Because aflatoxins are potentially hazardous to man and animals, rapid reliable procedures for testing their presence in agricultural commodities are necessary to prevent contaminated foods and feeds from reaching the market. Techniques of detecting aflatoxins should not only be simple and inexpensive, but also be rapid enough to aid the movement of commodities to market. The reliability of any analytical method for aflatoxin in corn depends on how the sample is taken and on its size. Methods of analysis fall into three categories: (1) Visual inspection of commodities (cotton-seed or corn) under ultraviolet light (365 nm) serves to locate lots that should be analyzed further because they may contain aflatoxin; (2) rapid screening procedures determine the presence or absence of the toxin, but not the levels present, although the sensitivity of a method sets a limit of detection; and (3) lengthy procedures are available to measure amounts of aflatoxin in agricultural commodities.

3692 • Starch-Polyacrylonitrile Copolymers. Properties of Hydrogels

E. B. Bagley and N. W. Taylor
Ind. Eng. Chem. Prod. Res. Dev. 14(2): 105-107. June 1975

Gel sheets prepared from high-viscosity aqueous dispersions of hydrolyzed starch-polyacrylonitrile graft copolymers absorb several hundred times their own weight in water. Viscosity of the dispersions can be reduced to low levels by mechanical shear before the films are cast to give solutions which yield water-soluble films. These soluble films can be readily crosslinked to again form highly swellable but nonsoluble gel sheets by: (a) heating, (b) irradiating with ^{60}Co , and (c) aging at high relative humidity.

- 3693 • Starch Xanthate-Polyethylenimine Reaction Mechanisms
M. E. Carr, B. T. Hofreiter, and C. R. Russell
J. Polym. Sci., Polym. Chem. Ed. 13(6): 1441-1456. June 1975

The chemical nature of starch xanthate (SX)-polyethylenimine (PEI) reaction products as wet-end additives has been studied because of their effectiveness for improving strength properties of paper. Model compounds, in conjunction with ultraviolet, infrared, and chemical analyses, served to elucidate SX-PEI reaction mechanisms. Aqueous solutions of SX (degrees of substitution 0.1-0.5) were titrated with PEI at pH 5-7 (25-30° C.) to form SX-PEI flocculent precipitates that were determined to be polyelectrolyte complexes. However, when solutions of SX-PEI were kept at pH 10-12, products were formed that included dithiocarbamic acid salts in major quantities, PEI thioureas, and minor quantities of *O*-starch PEI thiocarbamate.

Acid precipitation of these SX-PEI polymeric reaction products from their alkaline solutions, which contained residual xanthate and PEI, also yielded polyelectrolyte complexes. Model systems suggest that PEI thiuram disulfide and starch xanthide, possible products of air oxidation, could be present in minor amounts and would react rapidly with PEI to yield thioureas and thioncarbamates, respectively. Apparently, mixtures of xanthate and amine gave (1) dithiocarbamic acid salts from both xanthate groups and CS₂ (decomposition from xanthate); (2) thioureas from both dithiocarbamic acid salts and thiuram disulfide; and (3) thioncarbamates, principally from xanthate as opposed to xanthide.

- 3694* • Agriculture--Source of Raw Materials for Plastics:
Economic Considerations
Clarence A. Moore¹
(¹Economic Research Service, USDA, Peoria, Ill.)
*In Symp. "Renewable Resources for Plastics...," Div. Chem.
Mktg. Econ., 169th Nat. Am. Chem. Soc. meeting, Philadelphia,
Pa., pp. 73-86. 1975*

Some general and long-term considerations are discussed in comparing agriculture with the petroleum industry as an alternative source of raw materials for plastics. Ultimately, the relative (1) prices, (2) technical quality, and (3) supply conditions of agricultural and petroleum materials will determine which source will be used. Consequently, the major aspects of industry-wide demand and supply for the petroleum industry and for agriculture are reviewed, and their implications for future procurement of raw materials are outlined.

3695* • Current and Potential Uses of Starch Products in Plastics

Felix H. Otey

In Symp. "Renewable Resources for Plastics...," Div. Chem. Mktg. Econ., 169th Nat. Am. Chem. Soc. meeting, Philadelphia, Pa., pp. 87-99. 1975

Although numerous developments have been reported on how starch can be used to make plastics, these have failed to achieve large-scale market reality, largely because better and lower cost plastics can be made from other raw materials, particularly petroleum. Decreasing availability and increasing prices of conventional raw materials, coupled with greater demands for plastics, especially biodegradable and flame-resistant plastics, are forcing industry to consider starch in plastics. By 1980, the rigid urethane foam market could use 100 million pounds annually of starch-derived products, such as sorbitol, methyl glucoside, and glycol glycosides. Currently, only 1 to 2 million pounds of sorbitol enters this market. In the next few years, major growth is predicted for disposable packaging, food trays, plates, and eating utensils. Many of these articles could be made with starch as a filler to improve the rate of biodegradation upon disposal. Plastic films serve certain agricultural applications, but their failure to deteriorate causes problems. The largest application is for mulching where films are needed to provide weed control, conserve moisture and nutrients, and warm the soil for early crop production. The technology is available for incorporating starch materials in urethanes, in films, as filler for a great variety of resins, and for improving flame resistance of plastics.

3696* • Unsaturated Vegetable Oils as Renewable Resources for Plastics Applications

E. H. Pryde, L. E. Gast, E. N. Frankel, and K. D. Carlson

In Symp. "Renewable Resources for Plastics...," Div. Chem. Mktg. Econ., 169th Nat. Am. Chem. Soc. meeting, Philadelphia, Pa., pp. 100-116. 1975

As petroleum reserves dwindle in the United States and as the cost of imported petroleum rises, the question is asked, "Should the chemical and plastics industries call upon vegetable oils as starting materials to a greater extent than in the past?" The answer is probably best stated, "Fats and oils will continue to play a significant and growing role, but the vegetable oil industry could not possibly become the major base for the plastics industry because of limitations in crop production and land limitations." Nevertheless, vegetable oils are unique, annually renewable sources for fatty acids with remote unsaturation. Because of their long-chain aliphatic structure, fatty acid derivatives contribute flexibility, toughness, light stability, biodegradability, and low toxicity to many plastic products.

- 3697* • Egg Production, Shell Thickness, and Other Physiological Parameters of Laying Hens Affected by T-2 Toxin
 R. D. Wyatt,¹ J. A. Doerr,¹ P. B. Hamilton,¹ and
 H. R. Burmeister
 (¹North Carolina State University, Raleigh)
 Appl. Microbiol. 29(5): 641-645. May 1975

T-2 toxin has been reported to cause severe oral lesions and neural disturbances in young broiler chickens. When dietary T-2 toxin was given to laying hens at a level of 20 µg per gram of feed, oral lesions developed but there were no abnormal neural symptoms. T-2 toxin affected neither hemoglobin, hematocrit values, erythrocyte count, plasma glucose, pro-thrombin times nor sizes of liver, spleen, pancreas, and heart. Lipid content of the liver was not altered. Feed consumption, however, was reduced as were total plasma protein and lipid concentrations and total white cell count. Most important economically was the lowered egg production and a thinner egg shell. Timing and severity of the symptoms suggest that T-2 toxin causes primary oral lesions, which reduce feed consumption, and consequently reduces serum proteins and lipids, all of which culminates in decreased egg production. The leucopenia and thinner egg shell may be independent systemic effects of T-2 toxin in laying hens.

- 3698 • Aflatoxin Production in *Aspergillus flavus* Inoculated Ears of Corn Grown at Diverse Locations
 E. B. Lillehoj, W. F. Kwolek,¹ E. E. Vandegraft, M. S. Zuber,²
 O. H. Calvert,³ N. Widstrom,⁴ M. C. Futrell,⁵ and A. J. Bockholt⁶
 (¹Biometrician, North Central Region, ARS, USDA, Peoria, Ill.;
²University of Missouri, ARS, USDA, Columbia; ³University of Missouri, Columbia; ⁴Southern Grain Insect Laboratory, ARS, USDA, Tifton, Ga.; ⁵Mississippi State University, ARS, USDA, State College; ⁶Texas A&M University, College Station)
 Crop Sci. 15(2): 267-270. March-April 1975

Normal and *opaque-2* endosperm counterparts of two *Zea mays* L. hybrids were grown during 1973 at locations in Illinois, Missouri, Georgia, Texas, and Mississippi; 20 days after silking test ears were inoculated with *Aspergillus flavus* Link ex Fr. spores. Controls included untreated ears and mechanically damaged, uninoculated ears. Sample ears were harvested 15, 30, 45, and 70 days after treatment; after shelling the corn was ground, examined for bright-greenish yellow (BGY) fluorescence, and assayed for aflatoxin. Corn grown in Mississippi was heavily infected with a corn-stunting virus; reduction in plant development at this location required a modification of the test procedure. The number of aflatoxin-positives in 128 inoculated ears per plot at the other locations increased generally from North to South: Illinois, 28; Missouri, 86; Texas, 111; and Georgia, 117. The mean levels of aflatoxin B₁ in toxin-contaminated ears showed a

similar geographic pattern: Illinois, 2.4 p.p.b.; Missouri, 22.5 p.p.b.; Texas, 114.5 p.p.b.; and Georgia, 133.9 p.p.b. Almost all the toxin production occurred during the initial 30 days after inoculation. Fewer toxin-contaminated ears were found in the double-cross hybrid than in the single cross, but no significant difference in aflatoxin incidence was observed between endosperm types (normal vs. *opaque*). Sixty of 512 damaged uninoculated ears and 21 of 512 untreated control ears contained aflatoxin; 80% of the aflatoxin-positives associated with physically damaged or control ears were observed in corn from the Georgia location.

- 3699* • Oligosaccharides of Food Legumes: Alpha-Galactosidase Activity and the Flatus Problem
Joseph J. Rackis
ACS Symp. Ser. 15: 207-222. 1975

The raffinose family of oligosaccharides--including stachyose and verbascose--occurs in seeds of food legumes at levels that cause flatulence in man and animals. These carbohydrates escape digestion because there is no α -galactosidase activity in mammalian intestinal mucosa and because they are not absorbed into the blood. Consequently, bacteria in the lower intestinal tract metabolize them to form large amounts of carbon dioxide and hydrogen and to lower the pH. The amount and pattern of expelled gases reflect differences in type, location, and abundance of intestinal microorganisms possessing α -galactosidase activity in a favorable nutrient environment.

Water and aqueous alcohol extraction, as well as enzymatic hydrolysis, can be used to process food legumes into products having low flatus activity. According to *in vitro* and *in vivo* studies, antibiotics and naturally occurring substances can inhibit bacterial activity in the intestinal tract; however, it is unlikely such additives would be approved for human consumption. Breeding soybeans low in oligosaccharide content holds little promise.

- 3700* • Digestibility and Physiological Effects of Food Polysaccharides: Introduction [Part C]
John E. Hodge
ACS Symp. Ser. 15: 267-268. 1975

The more complex polysaccharides of much higher molecular weight, with the exception of starch, have been less studied by food scientists. Digestibility, fermentations in the bowel, bowel functions, and the lowering of serum lipids are the main physiological topics of interest in Part C of this symposium.

- 3701 • Digestibility of Food Polysaccharides by Man: A Review
Allene Jeanes
ACS Symp. Ser. 15: 336-347. 1975

Polysaccharides in human foods are either natural components or additives. Many of those not digestible serve beneficial functions physiologically, as well as for the food processor and consumer. The only polysaccharides known to be digestible are the α -glucans: starch, glycogen, and dextran having a low degree of branching. Specific enzymes cause digestion; i.e., for starch and glycogen, salivary and pancreatic α -amylases in conjunction with maltase(s) and limit dextrinases of intestinal mucosa; and for dextran, an uncharacterized 1,6- α -polyglucosidase (dextranase) of intestinal mucosa. Further information is needed on dextran-hydrolyzing enzyme(s) and interrelationships with limit dextrinases. Enzyme action may be inhibited by certain polysaccharides or by other substances in food. In view of the specificity of the known intestinal carbohydrases and the congruity in digestion of starch and dextran in rats and humans, preliminary reports of digestion of gum arabic and a β -1,3-glucan by the rat should be investigated further.

- 3702 • *Aspergillus flavus* and Other Fungi Associated with Insect-Damaged Field Corn
D. I. Fennell, E. B. Lillehoj, and W. F. Kwolek¹
(¹Biometrician, North Central Region, ARS, USDA, Peoria, Ill.)
Cereal Chem. 52(3, Pt. 1): 314-321. May-June 1975

White and yellow ear corn collected from fields in Missouri and Illinois was examined for damage by corn borers, earworms, mites, stinkbugs, and sap beetles and for the presence of these insects. Kernels selected from insect-damaged and insect-free ears were examined for fungi. The combined incidence of *Aspergillus flavus* on damaged and undamaged corn varied from 0 to 10.6% depending on the county surveyed; the average incidence was 5.2%. A 6.3% incidence of *A. flavus* on kernels from ears having insect damage differed significantly from the 2.5% incidence on kernels from undamaged ears. *Fusarium*, *Rhizopus*, and *Syncephalastrum* also were observed more frequently on kernels from insect-damaged ears. Similar distributions of fungal genera were observed on kernels from ears damaged by earworms and corn borers and by mites and stinkbugs. *A. flavus* was isolated from 15% of the 195 insects collected from freshly harvested ears. The fungus was associated with a significantly higher proportion of earworms (37%) than corn borers (14%).

- 3703 • Aflatoxin Occurrence in Some White Corn Under Loan, 1971.
I. Incidence and Level

Odette L. Shotwell, W. F. Kwolek,¹ Marion L. Goulden,
Linda K. Jackson, and C. W. Hesseltine
Cereal Chem. 52(3, Pt. 1): 373-380. May-June 1975

Aflatoxin was detected in 30% of 1,283 truckloads of Commodity Credit Corporation white corn (1971) delivered to a designated elevator from 77 loans in seven counties in southeastern Missouri (detection limit 1-3 p.p.b.). Only 14% of the truckloads of corn contained more than 20 p.p.b. aflatoxin. The toxin was not detected in any corn delivered from 20 of the farmers' loans. The geometric means of aflatoxin levels in corn from seven loans were higher than 20 p.p.b. Few truckloads of corn contained aflatoxin G₁. Based on geometric means of aflatoxin level of loans, toxin content was related to grade although with a low correlation coefficient of 0.29 for aflatoxin B₁ and 0.27 for B₂.

- 3704 • Aflatoxin Occurrence in Some White Corn Under Loan, 1971. II.
Effectiveness of Rapid Tests in Segregating Contaminated Corn

Odette L. Shotwell, Gail M. Shannon, and C. W. Hesseltine
Cereal Chem. 52(3, Pt. 1): 381-387. May-June 1975

Rapid screening tests for the detection of aflatoxin were made on truck-loads of white corn (1971 crop) under Commodity Credit Corporation as they arrived at an elevator in Missouri. Samples to be tested for the presence or absence of aflatoxin were selected on the basis of an inspection with ultraviolet light (365 nm) for bright greenish-yellow fluorescence associated with the presence of toxin. Results of the rapid field method were compared with those from quantitative determination and found to be effective, for the most part, in identifying aflatoxin-containing corn.

- 3705 • Scanning Electron Microscopy of Soybeans, Soy Flours,
Protein Concentrates, and Protein Isolates

W. J. Wolf and F. L. Baker

Cereal Chem. 52(3, Pt. 1): 387-396. May-June 1975

Soybean cotyledon fracture surfaces prepared by freezing in liquid nitrogen and samples of commercial soy flours, protein concentrates, and protein isolates were examined. Protein bodies and spherosomes characteristic of the native cellular structure were clearly discerned in the fracture surfaces and were also observed in a full-fat flour. Defatted flours likewise contained protein bodies; the largest number occurred in an unheated flour and the fewest were seen in a toasted flour. Protein concentrate made by

alcohol leaching contained protein bodies, whereas a concentrate prepared by acid leaching consisted of partially collapsed spheres. The latter probably formed during spray drying of the neutralized concentrate. Isoelectric isolate particles were rough in surface texture while proteinate forms of isolates were smooth, apparently as a result of differences in solubility during spray drying.

3706 • Volatile Components of Maturing Soybeans

D. H. Honig and J. J. Rackis

Cereal Chem. 52(3, Pt. 1): 396-402. May-June 1975

Soybeans were picked at intervals from 24 to 69 days after flowering and analyzed for major volatiles by vapor phase chromatography. Total volatiles measured as sublimates from whole soybeans decreased from a maximum value of 113 p.p.m. during early maturation to about 0.1 p.p.m. at maturity; yields from aqueous slurries of macerated beans decreased from 695 to 13 p.p.m. during maturation. The major constituent, methanol, accounted for 30 to 90% of total volatile content. Other major compounds were ethanol and ethanal, together with much smaller amounts of propanal, acetone, pentane, pentanal, and hexanal. Yields of volatiles from maturing soybeans began to decrease rapidly at the yellowing stage. On the other hand, flavor intensity values for bitterness increased twofold after yellowing. Some correlation was found between lipoxygenase activity and yields of ethanal in early stages of maturation.

3707 • Aflatoxin Incidence and Association with Bright Greenish-Yellow Fluorescence and Insect Damage in a Limited Survey of Freshly Harvested High-Moisture Corn

E. B. Lillehoj, W. F. Kwolek,¹ D. I. Fennell, and M. S. Milburn

(¹Biometrician, North Central Region, ARS, USDA, Peoria, Ill.)

Cereal Chem. 52(3, Pt. 1): 403-412. May-June 1975

Freshly harvested corn (40-45% moisture) from the 1972 crop was examined for *Aspergillus flavus*-induced bright greenish-yellow (BGY) fluorescence and for aflatoxin. Sample ears were screened for insects that could provide access for fungal infection. After the ears had been dried and shelled the corn was cracked, examined under an ultraviolet light, and extracted for aflatoxin assay. Samples from 5% of the test ears exhibited BGY fluorescence while those from 2.5% of the test ears contained aflatoxin B₁ in excess of 20 p.p.b. Essentially all of the toxin-containing samples were BGY-positive. Aflatoxin was detected in significantly more earworm-damaged samples than in those with no insect damage. Dramatic differences in BGY fluorescence incidence, aflatoxin occurrence, and insect damage were observed between test areas. No aflatoxin-positive samples were found in the seven fields of southern Illinois corn and in about two-thirds of 62 fields of southeastern Missouri corn. There was no association between recorded agronomic practices followed in the test fields and subsequent aflatoxin contamination.

- 3708 • Polymorphism in Single-Acid Triglycerides of Positional and Geometric Isomers of Octadecenoic Acid
J. W. Hagemann, W. H. Tallent, J. A. Barve,¹ I. A. Ismail,¹ and F. D. Gunstone¹
(¹St. Salvators College, The University of St. Andrews, Scotland)
J. Am. Oil Chem. Soc. 52(6): 204-207. June 1975

The polymorphism of 25 glycerol trioctadecenoates with double bonds ranging from Δ4 to Δ17 was investigated by differential scanning calorimetry. Triglycerides with *cis* bonds in odd positions Δ7 through Δ13 exhibited three intermediate melting (β' -) forms, but those with *cis* bonds in even positions, except *cis* Δ4, lacked β' -forms. Among the *trans* compounds, only Δ11, 13, and 14 showed β' -forms. The *cis* and *trans* Δ5 triglycerides were unusual, because they readily assumed low melting (α -) forms that were not easily converted to high melting (β -) forms. β -Form melting points of compounds in each series (*cis* or *trans*) alternated depending upon double bond position; an even position correlated with high melting point. Heats of fusion (ΔH_f) for β -forms, likewise, fluctuated with double bond position but nonuniformly; *trans* Δ6 had the highest ΔH_f (43 cal./g.), *cis* Δ12 the lowest (21 cal./g.)

- 3709 • Rheology of Dispersions of Swollen Gel Particles
N. W. Taylor and E. B. Bagley
J. Polym. Sci., Polym. Phys. Ed. 13(6): 1133-1144. June 1975

A centrifugal technique was used to determine the swelling, Q (gram swollen gel/gram dry polymer), of crosslinked polyacrylate gel particles in water. Both centrifugal force and time of centrifugation affected the magnitude of Q , but under constant centrifuge conditions it was found that Q^{-1} was proportional to $\mu^{1/2}$, μ being the ionic strength. The viscoelastic properties of water dispersions of these gel particles were measured as functions of concentration and ionic strength. Viscosity data were reducible to a normalized master curve by plotting (n_{sp}/c_r) versus c_r , where c_r is a reduced concentration defined as cQ . Values of shear modulus, G , computed from the first normal stress difference measured at various concentrations and ionic strengths also fell on a single curve when plotted against the reduced concentration, cQ . Comparison of these results with those obtained earlier on a similar polyacrylate dispersion, but one in which as much as 20% of the polyacrylate is in a soluble, uncrosslinked form, shows that the soluble fraction has little effect on the magnitude of the viscosity and, moreover, that the presence or absence of the soluble fraction does not affect the transient stress overshoot phenomenon. As in the earlier work, high absolute values of viscosity occur when $cQ \geq 1$, that is when the dispersion consists of close-packed deformable gel particles in intimate contact with little or no interstitial solvent present.

3710* • Linseed Oil: A Renewable Resource for Industrial Products

L. E. Gast

Proc. 44th Annu. Flax Inst. U.S., Fargo, N. Dak., December 6, 1974, pp. 11-13. [1975]

Shortages of petroleum have created the first serious energy crisis in United States history. Because petrochemical feedstocks are also in short supply, alternative materials are being sought. This review covers past and present work at the Northern Laboratory on the conversion of linseed oil into protective coatings, lubricants, and plasticizers and also emphasizes the "renewable resource" aspect of products based on agricultural crops.

3711* • Nutrient Digestibility and Metabolism in Lambs Fed
Added PerlolineJ. A. Boling,¹ L. P. Bush,¹ R. C. Buckner,² L. C. Pendulum,¹
P. B. Burrus,¹ S. G. Yates, S. P. Rogovin, and H. L. Tookey
(¹University of Kentucky, Lexington; ²University of Kentucky
and ARS, USDA, Lexington)

J. Anim. Sci. 40(5): 972-976. May 1975

Fourteen lambs were utilized in a metabolism trial to observe the influence of added isolated perloline on nutrient digestibility and metabolism. The lambs were fed a control diet or the same diet containing 0.5% of perloline monohydrochloride added at the time of feeding. The perloline monohydrochloride was isolated from 1,090 kg. of Kenwell tall fescue. In the perloline treatment group, apparent crude protein digestibility ($P<0.05$) and cellulose digestibility ($P<0.08$) coefficients were lower than those of the control group of lambs. Apparent digestibility coefficients for crude fiber, nitrogen-free extract, ether extract, and ash also tended to be lower in the perloline group. Urine volume and urinary nitrogen tended to be greater in the perloline treatment group. Nitrogen retained per day was 0.94 g. for the control and 0.44 g. for the perloline-fed lambs. Plasma urea nitrogen tended to be lower in the lambs fed perloline (12.27 mg./100 ml.). Ruminal acetic, isovaleric, and valeric acids were lower and propionic acid higher in the perloline-fed lambs. Body temperature of the perloline-fed lambs was higher than that of the control group on days 10 and 11 of the metabolism trial.

3712* • Fabricated Foods in Perspective

George E. Inglett

In "Fabricated Foods," ed. George E. Inglett, chap. 1,
pp. 1-6. Westport, Conn. 1975

Foods designed, engineered, or formulated from various ingredients, including additives, can appropriately be called fabricated foods. Fabricated foods are made by structuring, shaping, or blending various ingredients into finished food products. Such products are rapidly increasing in number in grocery stores.

Sales of fabricated foods were estimated at 13 billion dollars in 1972 and are predicted to grow to 23 billion dollars by 1980. Vegetable protein product sales were forecast to grow from 82 million dollars to 1.5 billion dollars during this period. This increase in sales is predicted on the basis of rising prices and shortages of meat expected by 1980.

3713* • Soy Proteins for Fabricated Foods

Walter J. Wolf

In "Fabricated Foods," ed. George E. Inglett, chap. 7,
pp. 49-67. Westport, Conn. 1975

A review of the preparation and physical and chemical properties of the three major soybean protein forms--flours and grits, concentrates, and isolates--that are used as ingredients of fabricated foods.

3714 • Properties of D-Xylose Isomerase from *Streptomyces albus*

Sergio Sanchez and Karl L. Smiley

Appl. Microbiol. 29(6): 745-750. June 1975

A partially purified D-xylose isomerase has been isolated from cells of *Streptomyces albus* NRRL 5778, and some of its properties have been determined. D-Glucose, D-xylose, D-ribose, L-arabinose, and L-rhamnose served as substrates for the enzyme with respective K_m values of 86, 93, 350, 153, and 312 mM and V_{max} values measuring 1.23, 2.9, 2.63, 0.153, and 0.048 μmoles/minute/mg. protein. The hexose D-allose was also isomerized. The enzyme was strongly activated by 1.0 mM Mg²⁺ but only partially activated by 1.0 mM Co²⁺. The respective K_m values for Mg²⁺ and Co²⁺ were 0.3 and 0.003 mM. Mg²⁺ and Co²⁺ appear to have separate binding sites on the isomerase. These cations also protect the enzyme from thermal denaturation and from D-sorbitol inhibition. The optimum temperature for ketose formation was 70 to 80° C. at pH values ranging from 7 to 9. D-Sorbitol acts as a competitive inhibitor with a K_i of 5.5 mM against D-glucose, D-xylose, and D-ribose. Induction experiments, Mg²⁺ activation, and D-sorbitol inhibition indicated that a single enzyme (D-xylose isomerase) was responsible for the isomerization of the pentoses, methyl pentose, and glucose.

- 3715 • Extracellular Polysaccharide from the Black Yeast
NRRL Y-6272: Improved Methods for Preparing a
High-Viscosity, Pigment-Free Product
Paul A. Sandford, Kermit A. Burton, Paul R. Watson,
Martin C. Cadmus, and Allene Jeanes
Appl. Microbiol. 29(6): 769-775. June 1975

When the extracellular polysaccharide from the black yeast NRRL Y-6272, composed of two parts *N*-acetyl-D-glucosamine and one part *N*-acetyl-D-glucosaminuronic acid, is isolated at maximum culture viscosity, adhering black pigment makes the polysaccharide preparations appear gray to black. Precipitation of the polysaccharide from cell-free culture supernatants with either ethanol or hexadecyltrimethylammonium bromide failed to remove the pigment. Various other methods were tried for obtaining a high-viscosity polysaccharide product free of pigment. By systematically varying ingredients of defined and semidefined media, an improved medium was found that not only gave polysaccharide preparations of increased viscosity, but also increased yield. A key ingredient in this medium is L-asparagine. Also, adding autoclaved bovine serum albumin or egg albumin to this medium at the time of inoculation allowed a pigment-free polysaccharide to be isolated by standard procedures. None of several other proteins or synthetic polyamides tested were as effective as bovine serum albumin or egg albumin. In an alternate approach, pink mutants, obtained by irradiation of the parent black strain with ultraviolet light, apparently produce the same extracellular polysaccharide free of any pigment but in lower yields or inferior in quality.

- 3716 • Phosphorus-31 Nuclear Magnetic Resonance Spectroscopy of
Extracellular Yeast O-Phosphonohexoglycans
Anthony J. R. Costello,¹ Thomas Glonek,¹ Morey E. Slodki,
and Fred R. Seymour¹
(¹University of Illinois Medical Center, Chicago, Ill.)
Carbohydr. Res. 42(1): 23-37. June 1975

A nondestructive instrumental technique can analyze the phosphate components in carbohydrate gums secreted by certain yeasts. Distinctive signals recorded correspond with known structural features of sugar-phosphate bonds. The narrow signals obtained imply that the phosphates are in uniform chemical and spatial environments even though a given polymer is not structurally homogeneous. The technique can identify similar chemical structures in bacteria, rat brain, and the cell walls of intact yeast.

- 3717 • Dioxolane and Dioxane Acetal Derivatives of D-Allose:
Condensation of 3-O-Benzyl-D-allose with Acetaldehyde
William E. Dick, Jr., David Weisleder, and John E. Hodge
Carbohydr. Res. 42(1): 55-63. June 1975

Condensation of 3-O-benzyl-D-allose with acetaldehyde forms a complex mixture from which potentially useful mono- and di-O-ethylidene derivatives were isolated and identified. Compounds isolated and identified after conversion of unsubstituted hydroxyl groups into the corresponding acetates included 1,2-di-O-acetyl-3-O-benzyl-4,6-O-ethylidene- β -D-allopyranose; 5,6-di-O-acetyl-3-O-benzyl-1,2-O-(R)-ethylidene- α -D-allofuranose; and two 3-O-benzyl-1,2:5,6-di-O-ethylidene- α -D-allofuranoses, both having the R configuration in the 1,2-O-ethylidene ring. Furanose and pyranose conformations were determined by nuclear magnetic resonance analysis, and the location and configuration of each acetal ring was established. The benzyl ether group in the furanose derivatives was removed by catalytic hydrogenation with subsequent formation of 3-O-acetyl analogs.

- 3718 • O-Ethylidene-D-Allopyranoses: 1,2-O-, 1,2:4,6-, and
2,3:4,6-Di-O-ethylidene Derivatives
William E. Dick, Jr., David Weisleder, and John E. Hodge
Carbohydr. Res. 42(1): 65-72. June 1975

Solutions of 1,2-O-acetoxonium chlorides derived from O-acetylated D-allopyranose derivatives were treated with sodium borohydride to give three pairs of previously unknown 1,2-O-ethylidene- α -D-allopyranose diastereoisomers: 3,4,6-tri-O-acetyl-1,2-O-ethylidene- α -D-allopyranoses; 4,6-di-O-acetyl-3-O-benzyl-1,2-O-ethylidene- α -D-allopyranoses; and 3-O-benzyl-1,2:4,6-di-O-ethylidene- α -D-allopyranoses. Examples of a second class of novel O-ethylidene-D-allopyranoses, the diastereoisomeric methyl 2,3:4,6-di-O-ethylidene- α -D-allopyranosides, were prepared by treating methyl 4,6-O-benzylidene- α -D-alloside with acetaldehyde-sulfuric acid. Assignments of dioxolane ring configurations and pyranose conformations were made by nuclear magnetic resonance analyses.

- 3719 • Patterns of Action of Glucoamylase Isozymes from *Aspergillus* Species on Glycogen
Helen J. Gasdorf, Poonsook Atthasampunna, Valentina Dan,
Dwight E. Hensley, and Karl L. Smiley
Carbohydr. Res. 42(1): 147-156. June 1975

Glucoamylase isozymes from black *Aspergillus* species have been freed of all traces of α -amylase by chromatography on Bio-Gel P-100, as evidenced by limited hydrolysis of oxidized amylose. Glucoamylase I retains its ability to hydrolyze rabbit-liver glycogen rapidly. By contrast, glucoamylase II hydrolyzes glycogen slowly, and addition of α -amylase to glucoamylase II does not enhance its activity toward glycogen. These results indicate that α -amylase is not involved in hydrolysis of glycogen by glucoamylase.

- 3720 • *Penicillium stoloniferum* Virus: Altered Replication
in Ultraviolet-Derived Mutants
P. E. Still, R. E. Dstroy, and C. W. Hesseltine
J. Gen. Virol. 27(3): 275-281. June 1975

Phenotypic mutants of the wild type of *Penicillium stoloniferum* NRRL 5267 were obtained from conidia exposed to ultraviolet light for 60 minutes (10% survival). Virus content of the wild type and of nine phenotypic mutants was determined by polyacrylamide gel electrophoresis. Four mutants had no detectable *Penicillium stoloniferum* virus F (PsV-F), whereas the other five had levels of PsV-F in the mycelium similar to the wild-type strain. All nine mutants and the wild type had comparable levels of *Penicillium stoloniferum* virus S (PsV-S). Maximum virus levels occurred after 9 days of submerged culture in a 2% yeast extract-15% sucrose medium. Virus replication in the fungal host continued after protein, RNA, and DNA synthesis leveled off. Virus levels ranged from 85 to 150 E_{260} units (extinction units at 260 nm in 1 cm. cell) per 4.7 to 5.3 g. dry weight of mycelium for the mutant strains compared to 106 E_{260} per 4.2 g. dry weight of the wild-type strain.

REPUBLICATION

- 3603 • Starch Graft Copolymers for Water Treatment
R. C. Burr, G. F. Fanta, W. M. Doane, C. R. Russell,
and D. A. Jones¹
(¹General Mills Chemicals, Inc., Minneapolis, Minn.)
Staerke 27(5); 155-159. May 1975

This paper was presented at a symposium on the flocculation and stabilization of solids in aqueous and non-aqueous media sponsored by the Chemical Institute of Canada, at Toronto on November 4-5, 1974, and was published in the Proceedings, pp. 253-271, November 1974.

CONTRACT AND GRANT RESEARCH PUBLICATIONS

[Report of research done by an outside agency under contract with the U.S. Department of Agriculture and supervised by the Northern Regional Research Laboratory.]

- 267-C* • Rapid Method for the Determination of Lysine in Cereal Grains Without Hydrolysis
Jose Madrid Concon
University of Kentucky, Lexington
Anal. Biochem. 66(2): 460-480. June 1975

[Report of research work supported with funds provided by the U.S. Department of Agriculture under the authority of U.S. Public Law 480, 83rd Congress, and sponsored by the Northern Regional Research Laboratory.]

- 362-F • Soybean Isoflavones. Characterization, Determination, and Antifungal Activity
Michael Naim, Benjamin Gestetner, Shmuel Zilkah,
Yehudith Birk, and Aron Bondi
Hebrew University, Rehovot, Israel
J. Agric. Food Chem. 22(5): 806-810. September-October 1974

January-June 1975

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PATENTS

[These patents are assigned to the Secretary of Agriculture. Copies of patents may be purchased (50 cents each) from the Commissioner of Patents, U.S. Patent Office, Washington, D.C. 20231. Order by number; do not send stamps.]

Flotation-Beneficiation of Phosphate Ores

Duane A. Jones and Wesley A. Jordan

U.S. Patent 3,862,028. January 21, 1975

An improved method of separating minerals from phosphate ores is described. The addition of silica depressants to flotation slurries substantially increases the efficiency of mineral separation and thereby reduces the number of flotation steps required to obtain a good yield of ore having the desired mineral concentration.

Process for Obtaining Full-Fat Oilseed-Protein Beverages Using Water and Initial Acid pH

Gus C. Mustakas

U.S. Patent 3,865,802. February 11, 1975

A process is disclosed for preparing a full-fat protein isolate in a highly stable dispersion which is particularly suitable as a non-flatulent milk-type beverage. The yields of protein and fat in the final product are as high as 96% and 83%, respectively.

Production of Harringtonine and Isoharringtonine

Richard G. Powell and Cecil R. Smith, Jr.

U.S. Patent 3,870,727. March 11, 1975

Alkaloids found to be chemotherapeutically active against certain strains of leukemia in mice are produced from *Cephalotaxus harringtonia*. The process includes extraction of plant parts with a polar solvent, partitioning the plant extracts between nonpolar and acidic aqueous solvents, making the aqueous portion basic, and removing the crude alkaloids from the basic aqueous solution. The crude alkaloids are purified and used in the treatment of leukemic mice.

Concrete-Curing and Antispalling Compositions

William L. Kubie

U.S. Patent 3,873,326. March 25, 1975

Oil-in-water emulsions are disclosed which exhibit significant improvements in concrete-curing and antispalling properties. This is accomplished by emulsifying mixtures of heat-bodied linseed oil or conjugated oils such as tung oil and boiled linseed oils.

LICENSING OF PATENTS

Many inventions and discoveries of the Northern Laboratory are covered by patents assigned to the Secretary of Agriculture.

Assigned patents are available for use by business and industry under either exclusive or non-exclusive licenses. Conditions

applicable to the granting of licenses are set forth in the Federal Register, May 14, 1970 [35(94): 7493-7495]. Further information can be obtained from the Administrator, Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250.

The Northern Regional Research Laboratory is part of the Agricultural Research Service of the U.S. Department of Agriculture. Congress in 1938 authorized four regional laboratories to conduct broad and complex investigations in the field of chemistry and related physical sciences to expand and improve the marketability of agricultural commodities. A fifth laboratory was completed in 1969 at Athens, Georgia. The addresses and commodities covered are:

<u>Laboratory</u>	<u>Principal Fields of Research</u>
Eastern Regional Research Laboratory 600 East Mermaid Lane Philadelphia, Pennsylvania 19118	Animals fats; dairy products; deciduous fruits; hides and leather; maple sap and syrup; meat and meat byproducts; potatoes and other vegetables.
Northern Regional Research Laboratory 1815 North University Street Peoria, Illinois 61604	Cereal grains: corn, wheat, grain sorghum, barley, and oats; oilseeds: soybean, flaxseed, and erucic acid-containing oilseeds; and new crops.
Richard B. Russell Agricultural Research Center P.O. Box 5677 Athens, Georgia 30604	Southeastern poultry, fruits, and vegetables; pecans and peanuts; forages and feeds; sunflower as an oilseed; pork; and tobacco.
Southern Regional Research Laboratory P.O. Box 19687 New Orleans, Louisiana 70179	Cotton and cottonseed; peanuts; rice; sweet potatoes; and sugarcane.
Western Regional Research Laboratory Berkeley, California 94710	Western fruits, nuts, vegetables, oilseeds, and rice; poultry products; forage crops; wheat and barley; wool and mohair; dry beans and peas; castor; and safflower.

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